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2,023,796

DRIVING BUSHING FOR ROTARY TABLES

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2 Sheets-Sheet 1

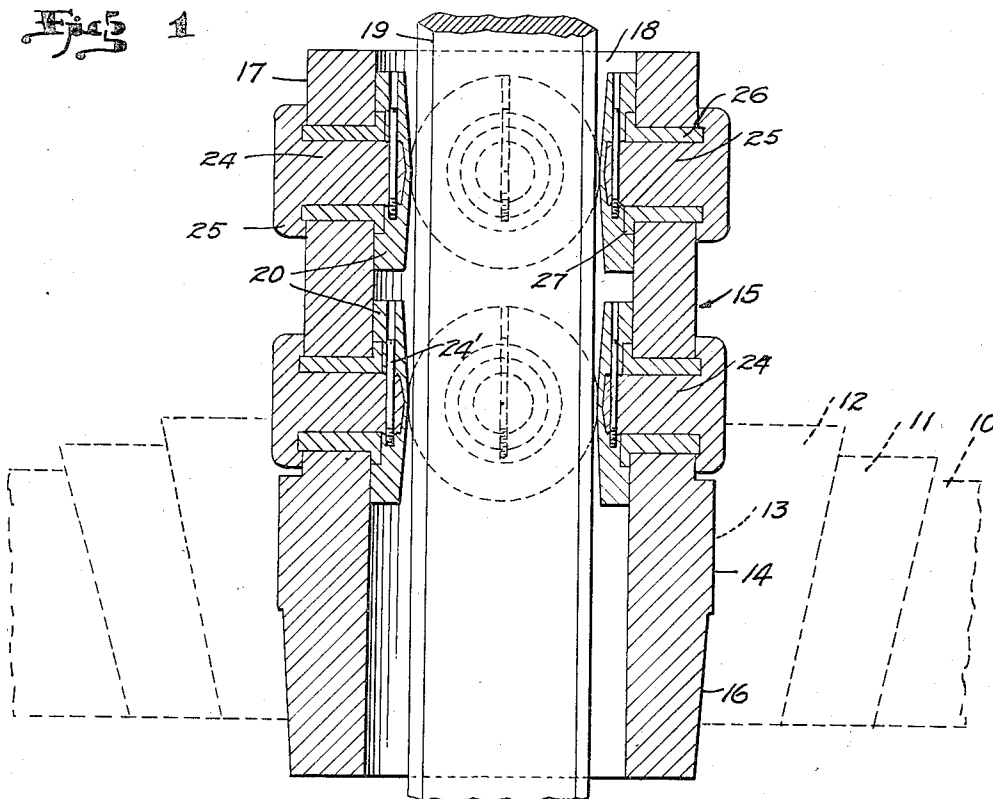


Fig 2

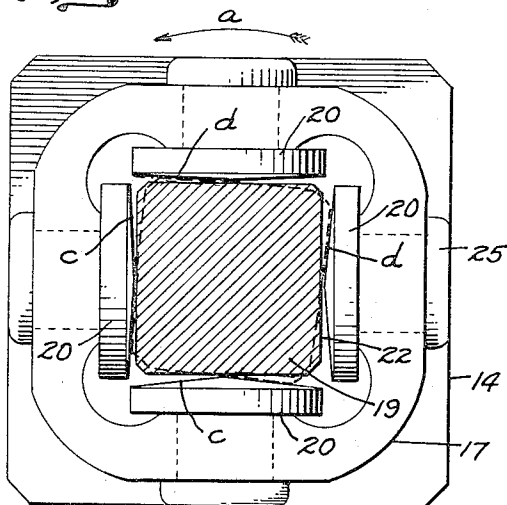


Fig 3

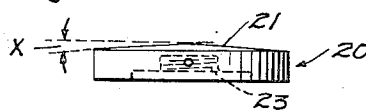


Fig 4



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Fig 5

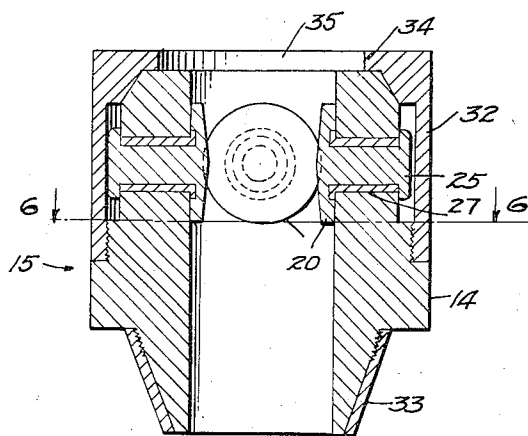


Fig 7.

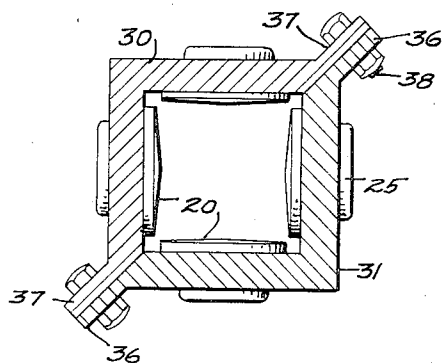
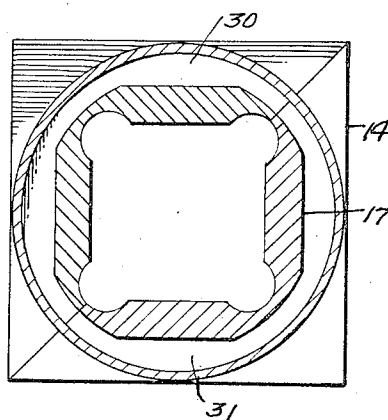


Fig 6.



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DRIVING BUSHING FOR ROTARY TABLES

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13 Claims. (Cl. 255—23)

This invention relates to a rotary well drilling apparatus and particularly pertains to a driving bar bushing for rotary driving tables.

In the operation of rotary well drilling equipment, particularly such as is used in the drilling of oil wells, it is the usual custom to provide a drill string with a driving bar which extends upwardly above the ground and which passes through a rotary driving table disposed to rotate in a horizontal plane, and through which the driving bar extends while in constant driving relation to the table. The driving bar, commonly known as the "kelly bar", is usually square in cross section and extends through a bushing at the center of the rotary table, which bushing has a square opening so that the driving bar may be constantly rotated with the table and so that at the same time the bar may have longitudinal reciprocating motion to permit the drill stem to be fed downwardly as the drilling operation proceeds, or to be drawn upwardly when desired to properly adjust the drill tool with relation to the earth formation being penetrated. It will be evident that due to the torque force imparted to the driving bar to rotate the same with the rotary table, there will be a material amount of frictional resistance tending to prevent easy longitudinal adjustment of the driving bar and to allow its slippage through the drill table, and since it is necessary to adjust the drill tool to a nicety, this frictional engagement of the driving faces of the driving bar with the contacting faces of the bushing in the rotary table will tend to retard drilling operations and add difficulty in properly fitting and setting the drill tool. It is the object of the present invention, therefore, to provide a driving bar bushing of peculiar design which will afford constant and direct driving torque for the driving bar and will at the same time permit vertical adjustment of the bar without material resistance from the bushing.

The present invention contemplates provision of a bushing which may be readily slipped into place over the "kelly bar" and its joint, and which is provided with anti-friction bearing means to engage the flat sides of the "kelly bar", and to assume a driving position with relation thereto which will permit the "kelly bar" to have longitudinal reciprocating movement irrespective of the driving torque which is being exerted against the bar.

The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a fragmentary view in section and elevation showing a "kelly bar" extending

through the rotary turn table of the driving rig and which turn table is equipped with the driving bushing with which the present invention is concerned.

Fig. 2 is a top view of the bushing as shown in Figure 1 with the "kelly bar" shown in cross section and indicates the driving relation of the "kelly bar" and the anti-friction members of the bushing.

Fig. 3 is a view in side elevation showing one of the anti-friction discs used in the bushing.

Fig. 4 is a view in elevation showing another form of anti-friction member in the shape of a roller which may be used in the bushing.

Fig. 5 is a view in central longitudinal section through another form of the invention in which a separable body is provided.

Fig. 6 is a view in transverse section through the structure shown in Fig. 5 as seen on the line 6—6 of Fig. 5, and showing the manner in which the body parts may be held together.

Fig. 7 is a view in end elevation showing another form of the invention, disclosing means for holding separable parts of the body together.

Referring more particularly to the drawings 25 10 indicates the rotary turn table of a rotary well drilling apparatus, which turn table may be fitted with the usual spider 11 receiving slips 12. The slips 12 are of a desired shape and size to provide a square opening 13 which receives 30 the squared shoulder 14 of the driving bar bushing 15 with which the present invention is particularly concerned. The shoulder 14 is formed around the bushing 15 at a point intermediate its ends, and divides the outer surface of the 35 bushing into substantially two portions; a conical extension 16 which extends downwardly from the shoulder to the slip 12, and a substantially square upwardly projecting extension 17 which extends above the level of the turn table 10. An 40 opening 18 extends longitudinally through the center of the bushing 15. This opening is substantially square in transverse section, and is of sufficient area to permit the "kelly bar" coupling to pass through it. The opening 18 is therefore 45 of considerably larger sectional dimensions than that of the "kelly bar" 19 which extends through it, and which bar is driven by the bushing. Direct driving contact between the flat sides of the square "kelly bar" 19 and the bushing is effected 50 by a pair of anti-friction bearing discs 20. As shown in Fig. 2 of the drawings, these discs are mounted in sets diametrically opposite to each other within the opening 18 of the bushing, and as seen in Figure 1 of the drawings. The discs 55

so positioned are arranged in vertical alignment upon the four sides of the bushing so that the driving thrust imparted from the bushing to the "kelly bar" will be applied at more than one point in the vertical plane represented by the various sides of the square bar. The discs 20 as clearly indicated in Fig. 3 of the drawings, are formed with a conical end face, the sides of which are disposed at an angle as indicated at "x" in Fig. 3. Due to this arrangement it will be evident that the rotary movement of the bushing will cause the side faces of the opening 18 to move out of positions in parallel alignment with the flat faces of the "kelly bar" and will place the inclined face 21 of each of the bearing discs 20 into contact with the corresponding flat face 22 of the "kelly bar" 19, and at one side of the rotary axis of the disc and thus at one side of the median transverse center of the "kelly bar". This action will produce driving contact between the "kelly bar" and the anti-friction disc along a line of contact radial of the axis of the particular disc, so that any longitudinal reciprocating motion of the "kelly bar" 19 with relation to bushing 15 will create frictional driving relationship between the face of the "kelly bar" and one side of the face of the anti-friction disc 20, while the portion of the "kelly bar" upon the opposite side of the disc as indicated on the vertical median line will be out of contact with the face of the disc a distance corresponding to twice the angle "x" indicated in Fig. 3. This same relation will prevail between all of the anti-friction discs 20 and all of the corresponding sides of the "kelly bar" 19 when the turn table is rotating constantly in a single direction. The discs 20 may be mounted in any desired manner, but are here shown as being provided with threaded bores 23 into which threaded spindles 24 extend. The outer ends of the spindles 24 terminate in enlarged heads 25 resting against the flat end faces of the bushing 26, thus insuring that when the spindles and discs are locked into place, the discs 20 will be firmly held at the end of the spindles. The spindles 24 extend through bushings 26 which have enlarged inner ends 27 extending into enlarged counterbores 23' in the end face of discs 20. In this manner the bushing will provide thrust and torque bearings for the discs 20 and spindles 24. The discs 20 are locked to the spindles 24 by lock pins or screws indicated at 24'. It will also be evident that due to this construction it is possible to withdraw the spindles 24 allowing the discs 20 to be removed so that the passageway 18 through the bearing 15 will be clear and unobstructed, as would be desirable in the event that a "kelly bar" coupling was to be passed through the opening 18.

In some instances it might be found desirable to substitute rollers 28 for the discs, in which event the rollers would be provided with a large diameter at a point midway their ends, thus forming two opposed frusto conical portions, either of which would provide an angular driving contact face with the "kelly bar".

A careful examination of the driving bushing here shown discloses the fact that the apices of the rotary discs or the crown portions of the rollers will be spaced apart on opposite sides of the bushing a distance substantially agreeing with the thickness of the "kelly bar" measured across its flat squared sides, and that these points will occur along the longitudinal median line of the flat sides of the "kelly bar" whereby a direct driving motion of the bushing will cause the anti-friction members to swing so that the radial

length of the disc or corresponding tapered length of the roller will swing into alignment and contact with the plane face of the "kelly bar" from its longitudinal median line to the edge of the disc, which distance represents substantially one-half the width of the face of the "kelly bar". When the discs are used it will be evident that the frictional engagement will take place between the contacting surface of the "kelly bar" and the corresponding radial length of the disc, while the opposite side face of the disc will be free, thus there will be a substantially rolling contact between the surface of the flat face of the "kelly bar" substantially from its longitudinal median line to the driving corner of the bar and from the rotary axis of the disc to its outer edge measured radially. This makes it possible for the "kelly bar" to move up and down within the bushing, at the same time causing the disc to rotate around its axis due to the fact that there is contact between the bar and the disc and one side of the axis of the disc only. Substantially the same result would be obtained in the use of oppositely tapered rollers, although the structure embodying the disc would no doubt carry a heavier load with less wear than the rollers due to the fact that the axes of rotation of the discs will be substantially parallel to the line of thrust, while in the case of the rollers the line of thrust will be substantially at right angles to the rotating axes of the rollers.

Referring more particularly to Figs. 5 and 6, another form of the invention is shown. This device is intended to provide the same desirable results in the use of a bearing, but contemplates means whereby the bushing may be placed on a "kelly bar" having enlarged ends. In this structure, 30 and 31 indicate separate complementary halves of a body structure generally indicated at 15 in the drawings. These parts are adapted to be assembled together along a longitudinal plane intersecting the longitudinal axis of the bushing so that the two parts may be readily assembled around a "kelly bar" and thereafter clamped together by an upper threaded sleeve 32 and a lower threaded sleeve 33. The upper threaded sleeve is cylindrical in shape and encompasses the portion of the bushing extending above the shoulder 14. The sleeve 32 is threaded onto the complementary parts 30 and 31 of the bushing and is provided at its upper end with an turned lip 34 which extends over the upper edge of the bushing so that the lock washers will be housed within the sleeve 32, and so that the entire upper structure of the bushing will be securely clamped together.

A central opening 35 will occur at the upper end of the sleeve to permit an enlarged portion of a "kelly bar" to readily pass through prior to assembly. The lower conical end 16 of the bushing is clamped together by the frusto-conical sleeve 33, which is threaded onto the conical extension at a point directly beneath the shoulder 14.

In the form of the invention shown in Fig. 7, the complementary halves, 30 and 31, of the bushing 15 are formed with bolting lugs 36 and 37 which may be clamped together by bolts 32. It will be evident that the separable parts of the bushing may be divided along diagonal lines if desired.

In operation of the present invention the bushing 15 is suitably mounted in slips 12 carried by the spider 11, after which the "kelly bar" and its coupling may be passed through the central opening 18 of the bushing. During this operation, it

is preferable to have the discs 20 removed from their operative positions. When the "kelly bar" coupling is passed through the central opening 18 the discs 20 may be mounted in their proper positions by the spindles 24 which pass through the bushings 27 and are locked with relation to discs 20 by the lock pins 24'. As previously explained, it is preferable to form the bushings 27 with an enlarged flange at their inner ends which will seat in the counterbore of the disc 20, thus providing a thrust bearing surface for the back faces of the discs 20 and torsional bearing surfaces for the spindle 24.

As previously explained, the dimension of the opening 18 in the bushing, plus the thickness of the discs, substantially agrees with the sectional measurements of the "kelly bar". There will be slightly relative rotational movement between the driving bushing 15 and the "kelly bar" as determined by the degree of angularity given the thrust face of the disc 20 as represented by the angle "x" indicated in Fig. 3 of the drawings. Thus, rotation of the bushing in the direction of the arrow "a", as indicated in Fig. 2 of the drawings, will cause the inclined radial face "b" of each of the discs 20 to swing into contact and transverse alignment with each of the flat faces of the "kelly bar", while the oppositely inclined face "c" of each of the discs will clear the corresponding flat faces of the "kelly bar", thus creating frictional engagement between the face portion "b" of each of the discs 20 and a corresponding face of the "kelly bar" 19, so that as the "kelly bar" moves up and down within the bushing the discs 20 will have a rotary motion as the surface portion "b" of each of the discs moves correspondingly, and the surface portion "c" moves oppositely.

In the form of the device shown in Fig. 4, the contacting portion "d" of the roller will rotate correspondingly with the "kelly bar", and the non-contacting portion "e" will, of course, move in a similar direction. In the event that the bushing 20 is caused to drive in a reverse direction from that indicated by the arrow "a", there will be lost motion between the face of the discs 20 and the flat faces of the "kelly bar" corresponding to twice the angle "x" indicated in Fig. 3, after which time the radial portions "c" will contact with the plane faces of the "kelly bar" upon the opposite side of the longitudinal median line of each of the faces so that the discs will rotate in opposite directions as frictional engagement of the flat faces of the "kelly bar" and the inclined face portions "c" of the discs occurs.

In view of the fact that the discs are made of hardened steel, there is no great possibility of wear, but if such wear should occur, it will be evident that the discs 20 may be readily interchanged and new ones substituted as desired.

It will thus be seen that the device here disclosed is quite simple in its construction and inexpensive as to manufacturing costs, and that it will provide means whereby constant driving torque may be applied to a driven member extending therethrough, while permitting the driven member to have relatively free longitudinal movement through the device.

While we have shown the preferred form of our invention, as now known to us, it will be understood that various changes may be made in combination, construction, and arrangement of parts by those skilled in the art without departing from the spirit of our invention as claimed.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:—

1. The combination of a tubular driving bushing, a driven shaft substantially square in cross section extending through said bushing to rotate in unison therewith, and to have longitudinal reciprocation relative thereto, and a plurality of anti-friction discs one for engagement with each flat face of the driven shaft, said discs being carried within the bore of the driving bushing and mounted to rotate upon axes in a plane at right angles to the axis of rotation of the shaft, said discs being formed with a crowned contact face whereby the discs will contact with the individual driving faces of the driven shaft along a line eccentric to their rotary axes.

2. A combination of a tubular driving bushing, a driven shaft extending therethrough adapted to rotate therewith and have longitudinal movement therethrough, said shaft being substantially polygonal in cross section to provide a plurality of longitudinally extending flat driving faces, anti-friction discs disposed within the opening through the driving bushing and separately arranged to contact with said driving faces whereby their rotary axes normally intersect the median line of the corresponding driving surfaces on the drive shaft, and the longitudinal axis of the shaft in a plane at right angles thereto, means for supporting said discs upon the bushing to rotate upon axes in said plane, the end faces of said discs being designed to contact with the driving surfaces of the driven shaft eccentrically of their rotating axes.

3. A combination of a tubular driving bushing, a driven shaft extending therethrough adapted to rotate therewith and have longitudinal movement therethrough, said shaft being substantially square in cross section to provide a plurality of longitudinally extending flat driving faces, anti-friction discs disposed within the opening through the driving bushing and arranged in pairs upon the diametrically opposite sides of said opening with their rotary axes normally intersecting the median line of the corresponding driving surfaces on the drive shaft, and the longitudinal axis of the shaft in a plane at right angles thereto, means for supporting said discs upon the bushing to rotate upon axes in said plane, the end faces being conical whereby driving contact between the bushing and the drive shaft will be established through engagement of the radial length of each of said discs at one side of their rotary axes only.

4. In rotary well drilling apparatus the combination of a rotary turn table, a "kelly bar" extending therethrough, said bar being characterized by being relatively square in cross section, a driving bushing through which the "kelly bar" reciprocates and with which it rotates in unison, a positive driving connection formed on the exterior of the driving bushing to engage the turn table structure, a plurality of diametrically opposed sets of driving discs mounted upon the wall of the opening through the driving bushing, the discs in each set being longitudinally aligned, and the discs of each set being arranged to engage a corresponding driving face of the "kelly bar", said discs having conical ends adapted to engage the driving faces of the "kelly bar", and means rotatably supporting the individual discs upon axes lying in planes at right angles to the longitudinal axis of the "kelly bar" and intersecting the same whereby rotation of the turn table and the bushing to impart torque to the "kelly bar" will cause the radial face of each of the discs to engage

the corresponding driving face of the "kelly bar" along an area eccentric to the axes of the various discs while permitting the remaining portion of the conical surface of each of the discs to be out of contact with the "kelly bar".

5. In rotary well drilling apparatus the combination of a rotary turn table, a "kelly bar" extending therethrough, said bar being characterized by being relatively square in cross section, a driving bushing through which the "kelly bar" reciprocates and with which it rotates in unison, a positive driving connection formed on the exterior of the driving bushing to engage the turn table structure, a plurality of diametrically opposed sets of driving discs mounted upon the wall of the opening through the driving bushing, the discs in each set being longitudinally aligned, and the discs of each set being arranged to engage a corresponding driving face of the "kelly bar", said discs having conical ends adapted to engage the driving faces of the "kelly bar", means rotatably supporting the individual discs upon axes lying in planes at right angles to the longitudinal axis of the "kelly bar" and intersecting the same whereby rotation of the turn table and the bushing to impart torque to the "kelly bar" will cause the radial face of each of the discs to engage the corresponding driving face of the "kelly bar" along an area eccentric to the axes of the various discs while permitting the remaining portion of the conical surface of each of the discs to be out of contact with the "kelly bar", and means for detachably holding the discs in their operative positions.

6. A device of the character described comprising a bushing through which a shaft extends and which bushing is formed with an enlarged shoulder at a point intermediate its ends, said bushing being formed of a plurality of segments longitudinally separable and assembled to form an encircling member, means embracing the upper end of the bushing for holding said segments in assembled relation, and means embracing the lower end of the bushing for holding said segments in assembled relation to each other, said embracing means being in the form of sleeves adapted to be slipped over the opposite ends of the bushing and to be held in position by threaded engagement therewith, the upper sleeve extending downwardly over the bushing and abutting against said shoulder, said bushing segments carrying separate anti-friction bearing means adapted to engage the shaft extending through the bushing.

7. A tubular driving bushing adapted to be mounted upon a shaft to be disposed in driving relationship to the bushing and to have longitudinal movement in relation thereto, said shaft being characterized as being polygonal in cross-section to provide a plurality of longitudinally extending flat driving faces, a sleeve forming a part of said bushing and through which the shaft extends, a plurality of rotatable anti-friction members carried within the bore of the sleeve, one of said members being provided for each of certain of said driving faces of the shaft to engage the same, said members being disposed with their axes in a plane transversely of the longitudinal axis of the shaft and each of said members being formed with a crown portion centrally thereof to normally contact the complementary flat driving face of the shaft and whereby relative rotation of the shaft and bushing will cause the face of the anti-friction bearing member at one side of said crown to move into line contact

with said driving face whereby relative longitudinal movement of the shaft with relation to the bushing will permit rotation of said anti-friction member.

8. In combination with a shaft of polygonal cross-section the diametrically opposite flat sides of which are parallel to each other, a driving bushing through which said shaft extends and with which it is in driving relationship, anti-friction members carried within the bore of said bushing and adapted to be in driving contact with said flat faces, the rotary axes of said anti-friction members being in a common plane transversely of the longitudinal axis of the shaft and said member being characterized as formed with a central crown normally contacting the complementary flat side of the drive shaft whereby one side of said crown may move into engagement with the complementary flat side of the shaft when relative rotation takes place between the shaft and the bushing.

9. A driving bushing adapted to be mounted for longitudinal movement upon a shaft of polygonal cross-section the diametrically opposite flat faces of which are parallel, said bushing comprising a sleeve through which said shaft extends, a plurality of rotatable anti-friction discs mounted within the bore of said sleeve and provided one for each of said plane faces, the axes of said discs being in a plane at right angles to the longitudinal axis of the shaft and normally perpendicular to the surface of the shaft with which said disk contacts, the end faces of said anti-friction discs being conical with the apices of said cones normally contacting the complementary faces of the drive shaft whereby relative rotation of the shaft and the bushing will result in contact of the inclined faces of said anti-friction discs with the corresponding flat faces of said drive shaft eccentrically of the axes of said discs.

10. A driving bushing adapted to be mounted for longitudinal movement upon a shaft of polygonal cross-section the outer surface of the shaft being formed with a plurality of longitudinally extending flat faces, said bushing comprising a sleeve through which said shaft extends and a plurality of anti-friction members carried by the sleeve and contacting with certain of said flat faces of the shaft, the anti-friction members being mounted to rotate around axes intersecting the shaft and disposed substantially at 90 degrees to the plane of the faces with which they individually contact.

11. A driving bushing adapted to be mounted for longitudinal movement upon a shaft of polygonal cross-section the outer surface of the shaft being formed with a plurality of longitudinally extending flat faces, said bushing comprising a sleeve through which said shaft extends and a plurality of anti-friction members carried by the sleeve and having contacting faces substantially at 90° to their rotary axes and contacting with certain of said flat faces of the shaft, the anti-friction members being mounted to rotate around axes intersecting the longitudinal axis of the shaft and being disposed substantially at 90 degrees to the plane of the faces with which they individually contact, and means whereby said anti-friction members may be removed from their operative positions in the sleeve without removing the sleeve from the shaft.

12. In combination with a driven shaft having longitudinally extending flat faces a driving bushing through which said shaft extends and by which it is driven, said driving bushing compris-

ing an anti-friction bearing disc mounted upon a rotary axis disposed at right angles to the longitudinal axis of the shaft and disposed within the bushing, the end face of said disc being conical with its apex normally in contact with the flat face of the shaft whereby rotation of the bushing in either direction will cause the conical end of the disc to assume a driving line contact with the flat face of the shaft.

10 13. In combination with a driven shaft having longitudinally extending flat faces a driving bushing through which said shaft extends and by

which it is driven, said driving bushing comprising an anti-friction bearing disc mounted upon a rotary axis intersecting the longitudinal axis of the shaft and disposed within the bushing, the end face of said disc being conical with its apex normally in contact with the flat face of the shaft whereby rotation of the bushing in either direction will cause the conical end of the disc to assume a driving line contact with the flat face of the shaft.

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